



**Seattle Public Utilities**

**2007 Water System Plan**

July 20, 2006  
Public Review Draft

**VOLUME I**

*[This page left blank intentionally.]*

## Acknowledgements

---

The following persons have contributed to the preparation of this *2007 Water System Plan*:

### Seattle Public Utilities Executive Directors

Chuck Clarke	Melina Thung	Nick Pealy
Karen Reed	Sharon White	Scott Haskins
J. Paul Blake	Tom Tanner	
Ray Hoffman	Nancy Ahern	

### Seattle Public Utilities Contributing Technical Staff

#### Joan Kersnar, Project Manager

Chris Anderson	Martin Baker	Dan Basketfield
Regina Beck	Julie Burman	Cheryl Capron
Deborah Caul	Alex Chen	Henry Chen
Alan Chinn	Gail Colburn	Darian Davis
Linda DeBoldt	Tracy DeLaTorre-Evans	Al Dietemann
Rich Donner	Jim Erkmann	Lisa Espinosa
Suzy Flagor	Bruce Flory	Jon Ford
Robin Friedman	Judi Gladstone	Rich Gustav
Wylie Harper	Laurel Harrington	Bill Heubach
Dave Hilmoe	Keith Hinman	Cyndy Holtz
Daniel Huang	Bob Keenan	Liz Kelly
Joy Keniston-Longrie	Celia Kennedy	Lynn Kirby
Brent Lackey	Karen Lanning	Jonathan Lewis
Rand Little	Nota Lucas	David Lujan
Eugene Mantchev	Dave Muto	Ralph Naess
Jim Nilson	Charles Oppelt	Ward Pavel
Ben Peralta	Guillemette Regan	David Reich
Marie Ruby	George Schneider	Jon Shimada
Tim Skeel	Marti Spencer	Emiko Takahashi
Bill Wells	Chris Wolf	Ned Worcester

### Consulting Contributing Technical Staff

#### **Brown and Caldwell**

Jack Warburton  
Matt Maring  
Andrew Lee  
Corinne De Leon  
Jim Tulley  
Tim Krause

#### **Johansen Consulting**

Dixie Johansen

Cover images by Hawk Jones/Kotagraph (*water glass*) and Roger Tabor, USFWS (*salmon fry*).

*[This page left blank intentionally.]*

## Certification

---

### Seattle Public Utilities

### 2007 Water System Plan July 2006

This 2007 Water System Plan for Seattle Public Utilities has been prepared under the direction of the following Registered Professional Engineers:



EXPIRES 12/2/06

Joan M. Kersnar, P.E.  
Seattle Public Utilities  
Seattle Municipal Tower  
700 Fifth Avenue, Suite 4900  
Seattle, Washington 98104-5004



EXPIRES 4/17/08

Matthew J. Maring, P.E.  
Brown and Caldwell  
701 Pike Street, Suite 1200  
Seattle, Washington 98101

*[This page left blank intentionally.]*

## Table of Contents

---

### 2007 WATER SYSTEM PLAN

<b>ACKNOWLEDGEMENTS .....</b>	i
<b>CERTIFICATION .....</b>	III
<b>TABLE OF CONTENTS .....</b>	v
<b>ABBREVIATIONS .....</b>	xvii

### EXECUTIVE SUMMARY

Purpose of the Water System Plan.....	ES-2
Six Years of Innovation and Progress: 2001-2006 .....	ES-2
Contents of the <i>2007 Water System Plan</i> .....	ES-3
Highlights from <i>2007 Water System Plan</i> .....	ES-3
Water Resources Business Area .....	ES-3
Water Quality and Treatment Business Area.....	ES-4
Transmission and Distribution Business Area.....	ES-5
Policies and Service Levels .....	ES-5
Plan Implementation .....	ES-7
Capital Facilities Budgeting.....	ES-7
Operation and Maintenance Cost Outlook.....	ES-7
Financial Program.....	ES-7
Conclusion .....	ES-8

### PART I: DIRECTION FOR BUSINESS AREAS

#### Chapter 1 – Introduction

1.1	Introduction to Drinking Water Line of Business.....	1-1
1.1.1	History of Water Business .....	1-1
1.1.2	System Description .....	1-2
1.1.3	Business Areas .....	1-4
<i>Major Watersheds Business Area</i> .....	1-4	
<i>Water Resources Business Area</i> .....	1-5	
<i>Water Quality and Treatment Business Area</i> .....	1-5	
<i>Transmission and Distribution Business Area</i> .....	1-5	
1.2	Corporate Policies that Shape How SPU Does Business.....	1-6
1.2.1	Asset Management Policy.....	1-6
1.2.2	Environmental Stewardship Policy.....	1-7

1.2.3	Security and Emergency Preparedness Policy .....	1-9
1.2.4	Meeting Customers Expectations Policy .....	1-10
1.3	SPU's Asset Management Business Framework.....	1-11
1.3.1	Service Levels.....	1-11
1.3.2	Project Development Plans .....	1-11
1.3.3	Strategic Asset Management Plans .....	I-12
1.3.4	Benchmarking .....	1-12
1.4	Current Planning Environment .....	1-13
1.4.1	Municipal Water Law .....	1-13
1.4.2	Regional Planning.....	1-14
1.4.3	Climate Change.....	1-14
1.5	Plan Organization.....	1-15
1.6	Plan and WAC Requirements .....	1-16

## **Chapter 2 – Water Resources**

2.1	Policies.....	2-1
2.1.1	Service Area Policy.....	2-1
2.1.2	Regional Role and Partnerships Policy.....	2-2
2.1.3	Planning for Uncertainty Policy.....	2-3
2.1.4	Supply Reliability Policy .....	2-5
2.1.5	Resource Selection Policy.....	2-6
2.2	Service Levels.....	2-7
2.2.1	Instream Flow Requirements .....	2-7
2.2.2	Water Conservation .....	2-8
2.3	Existing System and Practices .....	2-9
2.3.1	Service Area Characteristics .....	2-9
	<i>Changes in Demographics .....</i>	2-11
	<i>Retail Customers .....</i>	2-11
	<i>Wholesale Customers .....</i>	2-12
2.3.2	Water Demand .....	2-14
	<i>Historical Water Consumption .....</i>	2-14
	<i>Non-Revenue Water .....</i>	2-15
2.3.3	Water Conservation Programs .....	2-17
2.3.4	Infrastructure .....	2-18
	<i>Supply Sources .....</i>	2-18
	<i>Water Rights .....</i>	2-20
	<i>Firm Yield and Supply Reliability .....</i>	2-21
	<i>Agreement with Muckleshoot Indian Tribe .....</i>	2-21
2.3.5	Operations .....	2-22
	<i>Controlling Masonry Pool Seepage .....</i>	2-23
	<i>Operational Changes Due to Fish Passage .....</i>	2-23
	<i>Temperature Management at South Fork Tolt Reservoir .....</i>	2-23

2.3.6	Maintenance .....	2-24
2.4	Needs, Gaps, and Issues.....	2-24
2.4.1	Planning For Uncertainty .....	2-25
	<i>Forecasting Water Demand</i> .....	2-25
	<i>Evaluating Supply Alternatives</i> .....	2-30
2.4.2	Consistency With Other Planning.....	2-36
	<i>Coordinated Water System Plans</i> .....	2-37
	<i>Wholesale Customers' Individual Water System Plans</i> .....	2-37
	<i>King County COMPLAN</i> .....	2-38
	<i>City of Seattle's Comprehensive Plan</i> .....	2-38
	<i>Adjacent Purveyors</i> .....	2-39
	<i>Purveyors Beyond the Boundaries of SPU's Service Area</i> .....	2-39
	<i>Regional Wastewater Services Plan</i> .....	2-39
	<i>Watershed Plans</i> .....	2-40
2.4.3	Infrastructure Needs and Improvements.....	2-40
	<i>Chester Morse Lake Dead Storage Facilities</i> .....	2-40
	<i>Cedar Moraine Safety Improvements</i> .....	2-41
	<i>Landsburg Flood Passage Improvements</i> .....	2-41
2.4.4	South Fork Tolt Reservoir Studies.....	2-42
2.4.5	Supply Management Service Level .....	2-42
2.5.	Implementation/Action Plan .....	2-43

### **Chapter 3 – Water Quality and Treatment**

3.1	Water Quality and Treatment Policies .....	3-1
3.1.1	High-Quality Drinking Water Provision Policy .....	3-1
3.1.2	Watershed Protection Policy .....	3-3
3.2	Service Levels.....	3-5
3.3	Existing Facilities and Practices .....	3-6
3.3.1	Regulatory Requirements and Compliance .....	3-6
	<i>Total Coliform Rule</i> .....	3-6
	<i>Surface Water Treatment Rule</i> .....	3-7
	<i>Disinfection By-Product Rule</i> .....	3-8
	<i>Lead and Copper Rule</i> .....	3-9
	<i>Other Water Quality Monitoring</i> .....	3-10
3.3.2	Source Water Protection Programs.....	3-11
	<i>Watershed Protection</i> .....	3-11
	<i>Wellhead Protection</i> .....	3-11
3.3.3	Source Water Quality Summary .....	3-12
3.3.4	Source Treatment Facilities .....	3-13
	<i>Cedar River Treatment Facilities</i> .....	3-13
	<i>South Fork Tolt River Treatment Facility</i> .....	3-13
	<i>Well Field Treatment Facilities</i> .....	3-14

---

	<i>Condition of Source Treatment Facilities</i> .....	3-14
	<i>Overall Finished Water Quality</i> .....	3-14
3.3.5	In-Town Storage Facilities.....	3-14
	<i>Reservoir Covering/Burying</i> .....	3-15
	<i>Open Reservoir Protection Plan</i> .....	3-16
	<i>Water Quality Enhancements at Storage Facilities</i> .....	3-17
	<i>In-Town Reservoir Treatment</i> .....	3-17
3.3.6	Distribution System Facilities.....	3-17
3.3.7	Operations .....	3-18
	<i>Comprehensive Water Quality Monitoring Plan</i> .....	3-18
	<i>Cross-Connection Control Program</i> .....	3-18
	<i>New Water Main Testing</i> .....	3-19
	<i>Distribution Storage Facility Mixing and Cleaning</i> .....	3-19
	<i>Water Main Flushing</i> .....	3-20
3.3.8	Strategic Asset Management Plans For Water Treatment Infrastructure.....	3-20
3.4	Needs, Gaps, and Issues.....	3-21
3.4.1	Future Regulatory Changes.....	3-21
3.4.2	Emerging Contaminants of Concern.....	3-22
3.4.3	Water Quality at the Tap.....	3-24
3.4.4	Kerriston Road in the Cedar River Watershed .....	3-24
3.4.5	Lake Youngs Water Quality .....	3-25
3.4.6	Well Field Readiness .....	3-25
3.5	Implementation/Action Plan .....	3-27

## **Chapter 4 – Water Transmission System**

4.1	Transmission System Policies.....	4-1
4.1.1	Transmission System Redundancy Policy .....	4-1
4.1.2	Access to Seattle Regional Water Supply Policy .....	4-2
4.2	Service Levels.....	4-3
4.2.1	Pressure and Flow for Wholesale Customers .....	4-4
4.2.2	Wholesale Outage Duration .....	4-4
4.3	Existing System and Practices .....	4-5
4.3.1	Existing Facilities.....	4-6
	<i>Pipelines</i> .....	4-6
	<i>Storage</i> .....	4-7
	<i>Pump Stations</i> .....	4-9
4.3.2	Operations.....	4-10
4.3.3	Maintenance.....	4-10
	<i>Pipelines</i> .....	4-11
	<i>Reservoirs and Tanks</i> .....	4-11
	<i>Water Pump Stations</i> .....	4-11
	<i>Wholesale CustomerMeters</i> .....	4-12

4.4	Needs, Gaps, and Issues.....	4-13
4.4.1	Water Quality Issues in the Transmission System.....	4-13
	<i>Water Quality in Transmission Lines</i> .....	4-14
	<i>Control Works Tank Covering</i> .....	4-15
4.4.2	Pipeline Repair and Replacement .....	4-15
	<i>Concrete Cylinder Pipe</i> .....	4-15
	<i>Steel and Ductile Iron Pipe</i> .....	4-17
4.4.3	Cedar/Tolt Transfer Improvements.....	4-18
4.5	Implementation/Action Plan .....	4-18

## **Chapter 5 – Water Distribution System**

5.1	Water Distribution System Policies .....	5-1
5.1.1	Distribution System Redundancy Policy .....	5-1
5.2	Service Levels.....	5-2
5.2.1	Distribution System Pressure .....	5-3
5.2.2	Service Outages .....	5-4
5.2.3	Response to Distribution System Problems .....	5-5
5.2.4	Leaks .....	5-5
5.3	Existing System and Practices .....	5-6
5.3.1	Existing Infrastructure .....	5-6
	<i>Water Mains</i> .....	5-7
	<i>Distribution System Water Storage Facilities</i> .....	5-8
	<i>Distribution System Pump Stations</i> .....	5-9
	<i>Distribution System Appurtenances</i> .....	5-10
5.3.2	Distribution System Operation .....	5-12
5.3.3	Distribution System Maintenance.....	5-12
	<i>Water Mains</i> .....	5-13
	<i>Reservoirs and Tanks</i> .....	5-13
	<i>Water Pump Stations</i> .....	5-13
	<i>Water Appurtenances</i> .....	5-13
	<i>Record Keeping and Reporting</i> .....	5-15
5.4	Needs, Gaps, and Issues.....	5-15
5.4.1	Pressure-Related System Deficiencies.....	5-15
5.4.2	Aging Infrastructure.....	5-16
	<i>SPU's Approach to Water Main Replacement and Renewal</i> .....	5-17
	<i>System Leakage</i> .....	5-19
	<i>Projected Outages</i> .....	5-20
5.4.3	System Redevelopment.....	5-22
5.4.4	Backbone Pipeline System Seismic Upgrades.....	5-22
5.4.5	Customer Complaint Response.....	5-23
5.5	Implementation/Action Plan .....	5-25

## **PART II: PLAN IMPLEMENTATION**

### **Chapter 1 – Budget**

1.1	Capital Improvement Budgeting.....	1-1
1.1.1	Project Development Plan.....	1-1
1.1.2	Benefit-Cost Analysis .....	1-2
<i>Life-Cycle Cost Analysis</i> .....	1-2	
<i>Triple-Bottom-Line Analysis</i> .....	1-2	
<i>Risk Costs</i> .....	1-3	
1.1.3	Asset Management Committee Review.....	1-3
1.2	Business Area Actions and Costs .....	1-3
1.2.1	Water Resources .....	1-4
1.2.2	Water Quality and Treatment.....	1-4
1.2.3	Transmission .....	1-5
1.2.4	Distribution .....	1-6
1.2.5	Other Water Utility Capital Projects.....	1-6
1.3	Long-Range Capital Facilities Plan Budget.....	1-7
1.4	O&M Budget Outlook .....	1-9

### **Chapter 2 – Financial Program**

2.1	Financial Policies .....	2-1
2.2.	Financial Health.....	2-3
2.3	Funding Sources.....	2-5
2.3.1	Water Rates.....	2-6
2.3.2	Debt Financing.....	2-9
2.3.3	Debt-to-Assets Ratio.....	2-10
2.3.4	Alternative Financing Paths.....	2-11
2.3.5	Potential Financial Effects of Unanticipated Needs .....	2-11
2.4	Financial Model Cash Flow Analysis .....	2-13
2.5.	Conclusion .....	2-14

## **List of Tables**

---

### **Part I**

Table 2-1. SPU's Service Levels for Managing Water Resources Assets.....	2-7
Table 2-2. Demographic Changes.....	2-11
Table 2-3. SPU Wholesale Water Customers .....	2-12
Table 2-4. Components of Non-Revenue Water and Estimated Magnitudes .....	2-16
Table 2-5. Water Conservation Goals and Other Savings, Average Annual Savings, in mgd .....	2-27
Table 2-6. Summary of Traditional Supply Alternatives.....	2-32
Table 2-7. Summary of Reclaimed Water Project Alternatives .....	2-33
Table 3-1. SPU's Service Level for Managing Water Quality and Treatment Assets.....	3-5
Table 3-2. Water Quality Characteristics of SPU's Source Water, 2000-2005 .....	3-12
Table 3-3. SPU's Finished Water Quality Characteristics.....	3-15
Table 3-4. Schedule for Covering or Upgrading In-Town Open Reservoirs.....	3-16
Table 3-5. Annual Open Reservoir Cleaning Schedule .....	3-19
Table 3-6. Closed Storage Cleaning Schedule.....	3-20
Table 3-7. Future Regulations and Impact on SPU .....	3-22
Table 4-1. SPU's Service Levels for Managing Transmission System Assets.....	4-4
Table 4-2. Typical Pump Station Maintenance Activities .....	4-12
Table 5-1. SPU's Service Levels for Managing Distribution System Assets.....	5-3
Table 5-2. Projected System Leakage.....	5-20

### **Part II**

Table 1-1. Capital Improvement Program Budget, 2007-2012 .....	1-3
Table 1-2. Other Capital Projects and Six-Year CIP Costs .....	1-7
Table 1-3. Capital Facilities Plan Budget through 2030.....	1-8
Table 1-4. Comparison of Capital Facilities Plan Budget Estimates from 2001 and 2007 <i>Water System Plans</i> .....	1-9
Table 2-1. Financial Revenues and Expenditures, 2000–2005.....	2-5
Table 2-2. Summary of Water System Cash.....	2-13

*[This page left blank intentionally.]*

## **List of Figures**

---

### **Part I**

Figure 1-1. Seattle Regional Water Supply System.....	1-3
Figure 2-1. SPU's Water Service Area .....	2-10
Figure 2-2. Population Growth and Water Consumption from SPU Sources, 1975-2005 .....	2-15
Figure 2-3. Cumulative Water Savings from Conservation, in Average Annual mgd, 1999-2005.....	2-18
Figure 2-4. SPU's Official Water Demand Forecast .....	2-26
Figure 2-5. Uncertainty in Water Demand Forecast.....	2-30
Figure 2-6. Value Score vs. Levelized Unit Cost for Supply Alternatives.....	2-35
Figure 3-1. Monthly Coliform Data from SPU Water Distribution System.....	3-7
Figure 3-2. Trihalomethane Concentrations, 2002-2005 .....	3-9
Figure 3-3. Haloacetic Acid Concentrations, 2002-2005 .....	3-9
Figure 5-1. Range of Water Pressure within SPU's Distribution System .....	5-4
Figure 5-2. Year of Installation of SPU's Distribution System Water Mains .....	5-7
Figure 5-3. Long-Range Pipe Replacement Annual Cost Projection from Waverider for Different Types of Pipe .....	5-18
Figure 5-4. Long-Range Pipe Annual Repair Cost Projection from Waverider for Different types of Pipe .....	5-18
Figure 5-5. Projected Number of Services Affected by Outages Greater than 4 Hours per Year.....	5-21
Figure 5-6. Types of Water Quality Complaints in 2005 .....	5-24

### **Part II**

Figure 1-1. Proposed Capital Facilities Plan Spending through 2030.....	1-8
Figure 1-2. 30-Year O&M Budget Outlook .....	1-10
Figure 2-1. Rate Component Costs.....	2-7
Figure 2-2. Average Rate per CCF of Water .....	2-8
Figure 2-3. Comparison of Wholesale and Retail Water Rates .....	2-9
Figure 2-4. Past and Planned Debt Financing.....	2-10
Figure 2-5. Past and Projected Debt-to-Assets Ratio.....	2-11
Figure 2-6. Effect of Unanticipated Needs on Average System Rates .....	2-12

*[This page left blank intentionally.]*

## **Appendices (Volume II)**

---

- I. Water Resources
  - A. Official Yield Estimate and Long-Range Water Demand Forecast
  - B. Water Conservation Plan 2007 - 2012
  - C. Water Rights Evaluation
  - D. Water Shortage Contingency Plan
  - E. Reclaimed Water Opportunities
  - F. Groundwater Elevations at Seattle Well Fields
- II. Water Quality and Treatment
  - A. Treatment Assets Inventory
  - B. Administrative Rules for Cross-Connection Control Program
  - C. Comprehensive Water Quality Monitoring Plan
- III. Transmission
  - A. Transmission System Assets Inventory
  - B. Access to Seattle Water System Guidelines
- IV. Distribution
  - A. Distribution System Assets Inventory
  - B. System Design Standards
  - C. Distribution Facilities Design and Construction Standards
  - D. Distribution System Renewal Strategy
- V. Operations & Maintenance
  - A. Operator Certification
- VI. Budget and Finance
  - A. Capital Facilities Plan
  - B. Standard Connection and Administrative Charges Rule
- VII. Miscellaneous
  - A. Water Facilities Inventory
  - B. Water System Management and Personnel
  - C. Water Service Within the Direct Service Area and Connection Charge Policy and Procedures
  - D. Safety Procedures
  - E. Recordkeeping and Reporting Procedures
  - F. Potential New Interties between SPU and its Wholesale Customers
  - G. Hazard Identification and Vulnerability Analysis Summary
  - H. Plan Content Checklist
  - I. Seattle Zoning Map (provided in limited copies)

- VIII. Security Documents (withheld due to security concerns)
- A. Emergency Response Program
  - B. Water System Operation and Control
  - C. Water Treatment Chemicals and Suppliers

## **Abbreviations**

---

The following table defines abbreviations that are used frequently in this *Water System Plan*:

ASR	Aquifer Storage and Recovery
AWWA	American Water Works Association
BMPs	Best Management Practices
BPA	Bonneville Power Administration
CCF	hundred cubic feet
CCL2	Second Candidate Contaminant List
CCP	Concrete cylinder pipe
CCR	Consumer Confidence Report
CFP	Capital Facilities Plan
CI	cast iron
CIP	Capital Improvement Program
CO	carbon monoxide
COMPLAN	King County Comprehensive Plan
CPA	Conservation Potential Assessment
CRW CRMP	Cedar River Watershed Cultural Resources Management Plan
CRW HCP	Cedar River Watershed Habitat Conservation Plan
CRWEC	Cedar River Watershed Education Center
CUE	Conjunctive Use Evaluation
CWA	Cascade Water Alliance
CWSP	Coordinated Water System Plan
DI	ductile iron
DNS	Determination of Nonsignificance
EDC	Endocrine Disrupter Chemicals
EIS	Environmental Impact Statement

EPA	Environmental Protection Agency
ESA	Endangered Species Act
FCF	Flow Control Facilities
FERC	Federal Energy Regulatory Commission
FWP	Finished Water Pipelines
GIS	Geographic Information System
GMA	Growth Management Act
GPS	Global Positioning Satellite
HCP	Habitat Conservation Plan
HPA	Hydraulic Project Approval
I-63 SO	Initiative 63 Settlement Ordinance (Seattle Ordinance 120532)
IFA	Instream Flow Agreement
IWA	International Water Association
LAF	Limited Alternative to Filtration
LED	light-emitting diodes
LEED	Leadership in Energy and Environmental Design
LT2SWTR	Long Term 2 Surface Water Treatment Rule
LUAs	Limited Use Areas and Trails
MAC	Mycobacterium Avium Complex
MBR	membrane bioreactor
mgd	million gallons per day
MTBE	methyl tertiary butyl ether
MWL	Municipal Water Law
No.	Number
NPV	Net Present Value
O&M	Operation and Maintenance
OAHP	Office of Archaeological and Historic Preservation
OMI	Operations Management International

***SPU 2007 Water System Plan***

---

PDP	Project Development Plan
PHSKC	Public Health Seattle and King County
PPCP	Pharmaceuticals and Personal Care Products
PSCAA	Puget Sound Clean Air Agency
psi	pounds per square inch
PV	Present Value
RWSP	Regional Wastewater Services Plan
SAMP	Strategic Asset Management Plan
SCADA	Supervisory Control and Data Acquisition
SMP	Shoreline Master Program
SPU	Seattle Public Utilities
SWTR	Surface Water Treatment Rule
TPL	Tolt Pipeline
TPL1	Tolt Pipeline Number 1
USGS	United States Geological Survey
UV	Ultraviolet
WAC	Washington Administrative Code
W.D.	Water District
WDOH	Washington State Department of Health
WSAA	Water Services Association of Australia
WSP	Water System Plan

*[This page left blank intentionally.]*